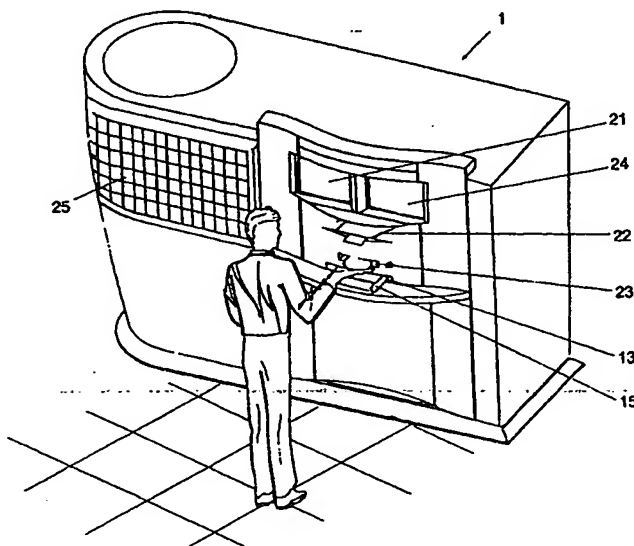




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(54) Title: VENDING MACHINE FOR MAKING AND SUPPLYING BOOKS



(57) Abstract

A vending machine (1) for making books which includes a computer data storage device (31) for storing a plurality of book titles, each including the text and image information, the cover information which may be in color, title and other identification of a plurality of books, an operating panel (2) including a display for displaying the identification information of the books stored in the storage device and the user's interface enabling a user to select one of the stored book titles for printing, and a book making apparatus for printing and binding the selected book.

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VENDING MACHINE FOR MAKING AND SUPPLYING BOOKS

FIELD OF THE INVENTION

The present invention relates to vending machines in particular to vending machines for making and supplying books.

5 BACKGROUND OF THE INVENTION

The invention is particularly useful when embodied in the form of a vending machine for making "books on demand", and is therefore described below with respect to such apparatus, but it will be appreciated that the invention, or various aspects thereof, can also advantageously be used in other forms of
10 book printing apparatus.

At the present time, the majority of book printing industry is based upon traditional printing technologies of pre-press, press and finishing tools. Thus, the conventional book printing requires the preparing of printing plates, printing and finishing a determinate number of copies for each book edition, and distributing
15 the printed books to stores and other retailers. Printing books in this traditional manner encounters problems of distributing the books, storing them, and particularly the uncertainty of the number of book titles to be printed in the respective edition. The returns of books to the publisher is approximately 40%, thus there is generally an overprint of 80-100%.

20 A number of machines have been designed for printing books in a digital manner "on demand", such as "Docutech 6180" manufactured by Xerox, "Demand Stream" manufactured by OCE and the "Infoprint" manufactured by IBM, . However, the known machines of this type are not efficient for printing pocket and paperback books of small format or in individual copies. In addition,
25 they are generally very expensive and not practical for implementation as vending machines which print and bind books in-situ and immediately following the user's request.

Existing, so called on demand, machines usually carry out only part of the functions needed to produce a complete finished book. Some of the functions
30 such as cover printing, binding and trimming are carried out off line and by

separate devices. Also a specialist is required to operate and supervise these operations.

The use of separate devices for different functions does not allow them to be incorporated within a vending machine.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a vending machine for printing and supplying books having advantages in one or more of the above respects. A particular object of the present invention is to provide book making apparatus which can be practically implemented as a vending machine for printing and binding books on demand and supplying them in real time. According to a preferred embodiment of the present invention, there is provided a vending machine for making books which includes a computer data storage device for storing a plurality of book titles, each including the text and image information, the cover information which may be in color, title and other identification of a plurality of books, an operating panel including a display for displaying the identification information of the books stored in the storage device and the user's interface enabling an user to select one of the stored book titles for printing, and book making apparatus for printing and binding the selected book.

Furthermore, according to a preferred embodiment of the invention, the book printing apparatus includes a black and white or color text and image engine for printing the text information of the selected book title on a plurality of pages in duplex mode, a covers print engine for printing the color cover information of the selected book title on front and back covers, a collator to collate the printed pages and the front and back covers of the book selected by the user, a binder for binding the printed pages and the covers collated by the collator and a controller for extracting from the source device a book title selected by the user. The controller also controls the pages printing engine, the cover printing engine, the collator, and the binder, for printing and binding the book selected by the user.

Furthermore, according to further features in the described preferred embodiment, the operating panel includes a payment device to be used by the user for paying for the selected book title, and a discharge device for discharging the selected book after having being printed by the text and color printing engines and bound by the binder. Preferably, the payment device in the operating panel includes a credit card reader.

According to further features in the described preferred embodiment, the operating panel further includes a diskettes reader for the insertion by the user of a diskette containing book information, to be printed and bound .

For example, the book file information in the data storage device could
5 be in the form of a plurality of CD-ROMs. A CD-ROM or diskette can also be used by the user who inserts the information media carrier (such as a CD-ROM or diskette) in the slot reader driver for automatic reading, printing and binding, of the book title. Alternatively, a remote device can be used to download book file information to the data storage device.

10 Preferably, paper storage and feeding, the operating panel, text and image printing engine, cover printing engine, collator and binder and all other components are all housed and operates in a fully automatic, on line process, under a common housing. The storage device for storing the plurality of book titles is also preferably housed within the common housing, but could be located
15 at a remote location and are connected by communication lines to the apparatus in Common housing.

As will be more particularly described below, book making apparatus constructed in accordance with the foregoing features may be practically implemented in the form of a vending machine located at publicly-accessible
20 locations for printing books "by request". The book title information can be stored in digital form in a highly efficient and compact manner such as CD-ROMs or Hard Disk permitting quick and efficient retrieval for printing and landing a book as or when requested a user. New book titles can be added in a simple manner, and old book titles that cease to be saleable can be removed from the storage device.

25 The foregoing features enable such a book printing apparatus to be constructed in the form of vending machines, providing many of the advantages that such vending machines offer, including elimination of book inventories, reduced distribution costs, minimal space requirements, automatic record-keeping, simplified inventory control, minimize the enormous percentage of
30 returns, common in the book trade.

Since the book title information, are stored in a compact digital way; such as a CD-ROM or hard disk, title information can be kept in several different languages for printing a language to the customer's requirements.

Further features and advantages of the invention will be apparent from
5 the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is an isometric illustration of a book vending machine constructed
5 in accordance with the present invention;

Figs. 2A and 2B are a block diagram and a schematic illustration, respectively, of the main components of a book printing apparatus of the vending machine of Fig. 1;

Figs. 2C illustrates the main components of the end product of the new
10 vending machine.

Fig. 3 schematically illustrates the various parts of the printing control unit including the electronic storing device in the apparatus of Fig. 1;

Fig. 4 schematically illustrates the various parts of the system control unit, including the electronic, drivers, etc., in the apparatus of Fig. 1;

Fig. 5 schematically illustrates the paper feeder and supply on which the
15 text and image information of a selected book title is printed;

Fig. 6 is an enlarged view of a portion of Fig. 5;

Fig. 7 schematically illustrates the print engine of Fig. 2A for printing the text and image of the book pages in a duplex mode on a web;

Fig. 7A schematically illustrates the print engine of Fig. 2A for printing
20 the text and image of the book in a duplex mode onto cut sheet pages;

Fig. 8 schematically illustrates the cutting mechanism downstream of the text and image engine assembly of Fig. 7;

Fig. 9 schematically illustrates the cover feeder for feeding the material
25 from a storage in to the cover print engine assembly;

Figs. 10 and 10A schematically illustrate the color cover print engine assembly for printing in a plurality of colors on both the front cover and back cover of the book;

Figs. 11A-11D illustrate various stages in the feeding of the front and
30 back covers to the collator in the apparatus of Fig. 2A;

Figs. 12A-12C illustrate various stages in the collation of the pages of text and the two covers in the collator of Fig. 2A;

Figs. 13A-13C illustrate binding of the collated pages and covers in book form;

Fig. 14 is a block diagram illustrating one form of data and control management system in the controller of Fig. 2A; and

5 Fig. 15 schematically illustrates the flow diagram of the main operations required for delivery of a book by the machine.

DESCRIPTION OF A PREFERRED EMBODIMENT

Reference is made to Fig. 1, which is an isometric illustration of a vending machine, generally designated 1, constructed and operative in accordance with the present invention. The vending machine contains book making apparatus, schematically illustrated in Figs. 2A and 2B, which prints and binds books according to a selection or request made by a customer, for "immediate" delivery to the customer.

A sample of a typical book prepared by the book making apparatus is illustrated in Fig. 2C. The book includes printed front and back covers 90F and 90B, respectively, enclosing a plurality of duplex printed pages, generally referenced 81, each side of a printed page referenced 51A and 51B. The printed pages 81 and front and back covers 90F and 90B, respectively, are collated and bound together and then glued together (glue shown by reference numeral 149). Finally, the book back up spine tape 143 is applied to produce the finished book.

The vending machine further comprises an operating and display panel, generally referenced 2, which includes a display screen 21 for displaying information related to the books and their printing, a credit card slot 22 for insertion of the customer's credit card, a slot 23 enabling the customer to insert a CD ROM or similar containing book title digital information which can be printed in the same manner as a selected one of the book titles stored within the machine itself and an outlet 13 for receiving the bound finished book.

Vending machine 1 (Fig. 1.) also includes a second display screen 24 which may be used for simultaneously displaying sample pages and other information related to a book, for example, and a hard copy sample display panel 25 for visual display of the book titles available from the machine.

Figs. 2A and 2B diagrammatically illustrates the main components of a book printing apparatus constructed in accordance with the present invention. Briefly, the book printing apparatus, illustrated in Figs. 2A and 2B, includes an operating panel 2, a printing control unit (PCU) 3, more particularly illustrated in Fig. 3; a systems control unit (SCU) 4, more particularly illustrated in Fig. 4; a paper web feeding unit 5, more particularly illustrated in Figs. 5 and 6; a text and image printing unit 6 for printing the pages of the book, more particularly illustrated

in Fig. 7 and 7A; and a collation of printing pages and related functions unit 7, 11 and 12 (Fig. 2A) more particularly illustrated in Figs. 8, 11A - 11D and 12A - 12C. The apparatus illustrated in Figs. 2A and 2B further includes a cover material feeder 9 upstream of a cover color print engine assembly 10, and another cover
5 feeder 11 downstream of assembly 10, as more particularly illustrated in Figs. 9, 10, 10A and 11a-11d, respectively. The printed sheets of text, and the printed covers, are fed to a collator and binder unit 12, more particularly illustrated in Figs. 12a-12d and 13-13a, respectively, for collating and binding the printed sheets of text and the front and back covers, to produce the complete bound book 15 which
10 is fed to a delivery chute 13 of the vending machine.

As will be described more particularly below, the printing control unit 3 includes a storage device for storing a plurality of book titles information, in the form of CD-ROMs or hard disk, for example, each file including the text and graphic information, cover information, and identification information of the
15 respective books. The operating panel 2 enables the user (a purchaser) to display the identification information of the stored book titles, and to select one of them for printing out in the form of a complete book 15 constituted of a plurality of pages having the text and images thereon, bound between front and back covers having cover information printed thereon. The payment may be by the insertion of
20 a credit card. When the credit has been approved and the selection made, the machine then automatically prints the text and image on a plurality of pages, and simultaneously also prints the information in color to appear on the front and back covers, and feeds both the printed text/image pages and printed covers to the collator 12 for collation and binding. The completely bound book 15 is then
25 delivered through the delivery chute 13.

Operating panel 2 includes monitors or displays 21 and 24 for displaying the identification information of the book title stored in the printing control unit 3. Operating panel 2 further includes an users' interface enabling the user to select one of the stored book titles for printing. In the example illustrated in Fig. 1, the
30 interface includes a touch-screen over display panels 21 and 24. Other interfaces may be provided, for example a keyboard having depressible keys.

The operating panel 2 further includes a credit card slot 22 for insertion of the users credit card to enable operation of the machine for ordering one or more of the books included in the book data storage of the print engine control unit. Operating panel 2 includes a further slot 23 enabling the user to insert an
5 information media carrier, such as a CD-ROM containing personal book title data carrier containing book file information, which can be ordered and printed in the same manner as a selected one of the book titles stored within the machine itself.

The print engine control unit 3, as illustrated in Fig. 3, includes a data storage device 31 for storing the plurality of book title information, e.g. in the form
10 of CD-ROMs or other digital media as indicated earlier, each book title includes the text and image, cover and identification information of the respective book selectable by the user for printing. The text and image digital data information is fed to the text and image engine, as shown schematically by line 32 in Fig. 3; whereas the cover digital data information is fed to the printing system for printing
15 the covers, as shown schematically by line 33 in Fig. 3.

Printing control unit 3 illustrated in Fig. 3 further includes a mother board 34 and a plurality of printer control boards 35 mounted thereon, for controlling the data flow operations of the two print engine assemblies.

The systems control unit (SCU) 4, as more particularly illustrated in Fig.
20 4, includes the electronic control for the various drives, as will be described more particularly below. It also includes a mother board 41, the system electronics 42, and a plurality of system driver and control cards 43.

In the machine illustrated in the drawings, the text and image is printed on a plurality of pages supplied from a paper web and cut into sheet form;
25 whereas the covers information is printed on pre-cut covers fed from a supply bin. Figs. 7-7A illustrate the manner in which the text/image is printed on the pages; whereas Figs. 10 and 10A illustrate the manner in which the cover information is printed on a front and back covers.

Thus, as shown in Fig. 5, the paper supply includes four rolls 50a-50d,
30 each capable of holding a considerable length of a paper web 51. Only one paper roll 50a-50d is active at any one time, and as soon as its paper web approaches depletion, another paper web is actuated in order to maintain a continuous supply

of paper until all the web rolls are exhausted. The paper roll is loaded and moved by any suitable movement means, such as motors, conveyors, rollers and servo-mechanisms, known in the art.

5 The supply of paper on the respective roll is sensed by a feeler arm 52 pivotally mounted at one end 53 and including a roller 54 engageable with the outer surface of the paper web on the respective roll. The pivotal mounted end 53 of the feeler arm 52 is coupled to a rotary encoder 55 which senses the angular position of the respective feeler arm 52 and thereby the supply of paper on the respective roll.

10 The paper web 51 payed out of its respective roll is past over a deflection roller 56 (Fig. 6) to a guide assembly for the respective roll. Thus, in the illustrated apparatus including four supply rolls, there would be four such deflection rollers 56 and four of such guide assemblies.

15 The deflection rollers 56 and the guide assemblies for the four rolls are more particularly illustrated in Fig. 6. Thus, each guide assembly includes a fixed guide element 57 and a pivotal guide element 58 pivotal towards the fixed guide element by a leaf spring 59. The fixed guide element 57 carries a driven pinch roller 60 aligned with another pinch roller 61 carried by the pivotal guide element 58, so as to drive the paper web 51 between the two. As indicated earlier a
20 separate deflection roller 56 and guide device 57-61 is provided for each of the four supply rolls 50.

The paper feeder further includes an exit guide device constituted of four guide elements 62A-62D spaced below the guide elements for the four paper rolls. The guide elements 62A-62D serve as an exit guiding device for driving and
25 guiding the paper web of the active roll 50 to the text and image engine assembly 7 illustrated in Fig. 7.

~~An indexing guiding device is interposed between the four guiding~~
devices, for the four rolls 50, and the common exit guiding device of guiding element 62A-62D. The indexing guiding device also includes a fixed guiding
30 element 64, and a pivotal guiding element 65 pivotal towards the fixed guiding element by a panel spring 66. In this case, however, the two guiding elements 64, 65 are carried by an indexing plate 67 which is pivotally mounted to index its two

guiding elements 64, 65 in alignment with the guiding elements 57 and 58 of the active paper roll 50, and the exit guiding device of elements 62A-62D. Indexing plate 67 is pivotal to a selected position by a pulley assembly 68 driven by a motor 69 under the control of the systems controller to align the two indexible guiding
5 plates 64, 65 with the guiding device 57-58 of the roll which is active at any particular time to pay out the paper web.

As seen particularly in Figs. 5 and 6, the four paper supply rolls 50, and their deflection rollers 56, are arrayed in the form of a arc over the indexer guide 64, 65, such that the indexer guide may be pivotally mounted to align any one of
10 the roller guiding devices with the exit guiding device, elements 62A-62D, according to the roll which is active. As seen particularly in Fig. 6, the two guiding elements 57, 58 alternate in length with respect to the four rolls 50. Thus, the guiding elements for rolls 50c are long, those for the next roll 50a are short, those for the next roll 50b are long, and those for the next roll 50d are short. Such an
15 arrangement minimizes the space occupied by the rolls and their respective guiding elements, thereby providing a compact structure for holding a large supply of paper to be used for printing a large amount of pages.

Fig. 7 more particularly illustrates the print engine 6 of Fig. 2A for printing the text/image of the book. This print engine is an ink-jet printer of the duplex
20 type, i.e. printing on both sides of the paper web 51. In Fig. 7, the paper web 51 enters the print engine assembly from the right side via a guide plate 70 and 71 and is driven by rollers 72 onto the upper surface of a horizontal, closed-loop conveyor belt 73a driven by a pair of pulleys 74a in the direction of the arrow shown in Fig. 7. A print engine unit 75a is located above the upper surface of
25 conveyor belt 73a so as to print the text/image information on the upper face of the paper web 51 as it is driven under the print engine unit. Print engine unit 75a may be a seven ink-jet module, each with its own drivers, as described for example in Patent No. EP 0640481 B1 assigned to the same assignee as the present application. For clarity, the ink-jet modules control and ink reservoirs are
30 not shown in the figures. If desired, a dryer unit 76a such as an IR (infra red) or UV (ultra-violet) radiation unit may be used at the outlet end of the print engine unit 75a.

A second print engine head 75b is located to print on the opposite side of the paper web as it leaves the closed-loop conveyor belt 73a and is received on the close-loop conveyor belt 73b underlying conveyor belt 73a. Thus, after one side of the paper web has been printed while being conveyed by conveyor belt 73a under print engine head 75a, the paper web is inverted as it is fed to the underlying conveyor belt 73b so that it can be printed upon. A separate dryer 76b may also be provided for drying the ink applied by print engine unit 75b.

The print head 75B (75A is similar) is illustrated in-blown up detail in Fig. 7. Briefly, the print heads 162 eject droplets 164 of ink on to web 51 being carried by loop conveyor belt 73B forming the printed web 51B.

Similarly printed web 51A is printed using print head 75A and carried by conveyer 73A.

The paper web may be secured and moved with the conveyor belt in any suitable manner, such as by vacuum (not shown) or other similar techniques known in the art.

The conveyor belt system and its utilization in printing technology is well known in the art and is thus not described in further detail.

Fig. 8, which is a continuation upstream of the text and image engine assembly, illustrates the manner of handling the paper web 51 after it has been printed on both sides (referenced 51A and 51B) with the text and image information. Thus, the paper web 51 passes via guide 89 through a pair pinch rolls 79 and continuous via pinch rollers, 82, over a cutter table generally referenced 83 on which is mounted a cylinder 84 having a cutter blade 85 extending longitudinally of the cylinder, so as to be transverse of the paper web 51. The circumference of the cylinder 84 and the synchronization between the web speed and cylinder 84 to define the cut sheet size. Thus, the cylinder 84 is located at the appropriate speed with respect to the feed of the paper web 51 so that the cutter blade 85 slits the paper at the proper locations to produce the separate printed sheets 81. These sheets are removed via an inclined chute 86, to a collecting bin 7 and fed to the collating and binding unit 12 of Fig. 2A as described more particularly below with respect to Figs. 12 and 13.

Fig. 7A illustrates a variation wherein the cutter is located upstream of the print engine heads, rather than downstream as illustrated in Fig. 7. Thus, in the variation illustrated in Fig. 7A, the guiding plate 91 for guiding the paper web 51 into the first print engine head 75a includes a cylinder 92 formed with a cutter blade 93 extending longitudinally of its cylinder 92, and therefore transversely of the paper web, similar to cylinder 84 and cutter blade 85 in Fig. 8, so that the cutter blade slits the paper web into the appropriate size sheets 81a before the paper sheets are fed by the conveyor belt under the first print engine head 75a. In addition, at the end of the print engine head 75a the conveyor belt is provided with a plurality of guide rollers 47 to guide the individual sheets via guiding plate 77A to the underlying conveyor belt for printing on the opposite side by the second printing head 75b. In all other respects, the construction illustrated in Fig. 7A is the same as described above with respect to Fig. 7.

Figs. 9-11 illustrate the covers print engine system for printing the cover information of the selected book on the front and back covers.

The pre-printed covers, referenced as 90 in Fig. 9, are pre-cut and supplied from a bin 91. The bin includes a lift plate 92 on which the covers 90 are stacked and are fed from the top by a motorized drive roller 93 carried by a pivotal arm 94 so as to be in engagement with the top cover of the stack. The lifting mechanism includes a motor 95 driving a screw 96 via a gear train 97, which screw is steadily received within a nut 98 fixed to bin 91, so that rotation of Motor 95 in one direction raises lifting plate 92, and rotating it in the opposite direction lowers the lifting plate. Motor 95 is controlled in synchronism with drive rotor 93 to raise the lifting plate 92 one increment as the drive roller drives the top most cover via guide 99 to the covers printing unit 10 of Fig. 2A, more particularly illustrated in Figs. 10A.

~~The printing of the covers information is preferably by the "thermal~~
transfer" technique, in which a transfer is effected of the color from a color transfer ribbon. The thermal transfer" technique is known in the art and described for example, in "Hard Copy and Printing Technology" by Ken-Chi Shimmed, published in SPIE Proceedings Vol. 1252 1996.

Thus, as shown in Fig. 10, the pre-printed covers 90 are individually fed via guide 99 onto a closed-loop conveyor belt 100 driven by a pair of pulleys 101 so as to be transported under four thermal transfer print heads 102a-102d, in succession. Each print head includes a color pigment-carrying ribbon 103 fed from a supply reel 104 and then pass print heads 102A-12D to a surplus reel 106. The print heads 102a-102d are digitally controlled to produce hot points which cause a minute point of the color pigment from the respective color pigment carrying ribbon 103 to transfer to the cover 90. The four print heads 102a-102d print, in this manner, four process colors C, M, Y, K (Cyan, Magenta, Yellow and Black), although additional printing heads and special colors, such as metallic colors, are possible.

Both the front cover 90F and back cover 90B are printed on one face of the cover material by the print heads 102A-102D. As best seen in the detail of Fig. 10A, the covers, both front 90B and back 90F, are carried along the conveyor 100 to feeder unit 11.

Since both the front cover 90F and back cover 90B for the book are printed on but one face, namely that facing the print heads 102a-102d in Fig. 10, the feeder unit 11 in Fig. 10A includes an inverter device 111 which inverts one of the covers, namely the front cover, so that its printed surface faces downwardly at the time the cover is fed to the collator and binder (7 and 12).

The cover feeder unit 11 of Fig. 10A, and the various stages in its operation, are illustrated in Figs. 11a-11d. Thus, the conveyor belt 109 conveys the covers 90 from the printing heads 102a-102d (Fig. 10) to another conveyor belt 110 leading to the collator and binder unit 12 (Fig. 12). An inverter mechanism 111 is provided at the transfer point between the conveyor belts 109, 110.

~~Inverter mechanism 111 is of a box-like construction rotatable 180°~~
about its axis 112 by means of a motor 113. When a front cover 99F is to be transferred from conveyor belt 100 to conveyor belt 110, the latter being located slightly below conveyor belt 100, the front cover 90F is received by the inverter mechanism 111 and actuates a sensor (not shown) which energizes its motor 113 to rotate the inverter 180°, as shown in Figs. 11b and 11c, to thereby invert the

front cover 90F so that its printed side faces downwardly as it is received on conveyor belt 110. In this position, the inverter mechanism 111 serves as a guide for directing the succeeding back cover 90B onto the conveyor belt 110 with its printed side facing upwardly, as shown in Fig. 11d.

5 The collator and binder unit 12 (in Fig. 11D) receives both the printed pages from the ink-jet duplex print engine 6 and also the printed covers as printed by the color printing unit 10 and fed by the feeding unit 11. Figs. 12A-12C illustrate the manner in which the printed pages and the two covers are collated in unit 12; and Figs. 13A-13C illustrate the grinding gluing, and insertion of the book spine backing tape 143 and gluing of the spine to bind the pages and covers into
10 a complete book. The glue referenced 149 is best seen in Fig. 2C.

Referring now to Figs. 12A-12C, the collator includes a collator frame 130 pivotal about an axis 131. During the collation process, frame 130 is inclined at an angle optimal to receive the printed pages 81 at approximately 30° angle as
15 shown in Fig. 12A. The two sided printed pages 81 moved via chute 86 of the printing unit 6 are sequentially received on the fork 132 to form a stack, with the first page of the book being received first and facing downwardly.

The front cover 90F is fed from conveyor belt 110 under the fork 132 carrying the stack of sheets 81 or 81a (Fig. 12B), , the front cover 90F, which has
20 been inverted so that its printed side faces downwardly as described above with respect to Figs. 11a-11d, can be inserted at any time during the printing of the sheets 81 or 81a and does not have to wait until all sheets are printed. The fork 132 is then removed, to permit the front cover 90F and the stack of printed sheets thereon to rest against the bottom plate of the collator frame 130, and then the
25 back cover 90B is fed to the upper side of the stack of sheets 81 its printed side facing upwardly, as shown in Fig. 12C.

After the back cover 90B has been thus inserted, a clamping plate 133
is driven into firm contact with the back cover 90b by means of a clamp screw 134 driven by an electric motor 135 via a gear and pulley 136. Clamping plate 133
30 thus firmly presses the printed pages 81 or 81a of the book and the two covers 90F, 90B firmly against the bottom plate of the collator frame 130.

Referring now to Figs. 13A-13C, the collator frame is rotated about its axis 131 to the position illustrated in Fig. 13A, to enable the stack of sheets and covers to be bound together in book form. In this position, the spine 148 of the book faces downwardly. The printed pages and the two covers may be bound together to form the finished book 15 by the technique illustrated in Figs. 13B-13C, wherein glue 149 is applied to the spine of the book to glue the sheets 81 or 81a and cover 90B-90F together after which a back-up spine tape 143 is applied to the spine side of the book. Thus, as shown in Fig. 13B, a glue applicator 140 transfers glue 149 from a container 141 to the spine of the book. The glue 149 may be of the cold type, or hot-melt type. In the latter case, container 141 would be provided with a heater 142 for heating the glue.

As shown in Fig. 13C, the binding is effective by a back-up tape 143 which is applied by rollers 144, and two side rollers 145.

Before the book spine is coated with an adhesive, the spine of the book may be roughened by a rotating cutter, as shown at 146 in Fig. 13A. This roughening may generate dust, and therefore a dust collecting system 147 may be provided for this purpose.

If a hot glue system is used for binding the book, as shown in Fig. 13B, such a system should be equipped with a fumes exhaustor (not shown). If the binding is by adhesive tape, as shown in Fig. 13C, the adhesive tape is preferably heat-activated, and the back and side rollers 144, 145 are preferably spring-loaded and heated..

After the book has been printed and the binding applied as described above, the book is released onto the delivery chute 13 illustrated in Fig. 1.

Reference is now made to Fig. 14, which is a block diagram illustrating the data and management system controller units 4, shown in Figs. 3 and 4 which control the overall operation of the machine. Thus, the storage device therein designated 31, stores a plurality of book title information in the form of CD-ROMs, with each book title including the text/image, cover information, and identification information of the respective books. The controller 35 includes a program manager 202 and an operation user interface 205. Upon the selection of a book title, the program manager 202 identifies the data location and directs the

text/image information of the respective book title to a page printing raster image processor (RIP) 204, and the covers information to a cover RIP 206 which converts the information to a bit map format. Generally, the text information is black-and-white, whereas the covers information is multi-colored. The text/image and covers may, however, be printed in any combination of color and black and white. The text/image information is printed on the paper web (or sheets) by the duplex print engine 6, as more particularly illustrated in Fig. 7: whereas the cover information is printed on the front and back covers by the color print engine unit 10, as more particularly illustrated in Fig. 10. After all the pages have been printed with the text/image of the selected book, and the two covers have been printed and collated with the printed pages of the book title, the printed pages and covers are collated and bound together into the final book form 15 by the collating and binding unit 12 as described above with respect to Figs. 12 and 13.

As also described above, system controller 42 includes the electronics and print engine drivers 43, shown by box 4 in Fig. 4 for controlling the text/image pages print engine unit 6, the cover print engine unit 10, and the collator and binder units 7, 11 and 12, and to print and bind the book selected by the user, as well as other motors or actuators.

Reference is now made to Fig. 15, which is a flow chart illustration of the operation of the book making and supply vending machine 1. A customer, wishing to order a particular book title, orders the book title from the list of title available (step 302). The available book titles are shown on a display panel 25 (Fig. 1).

The ordered book title is then located in the data storage device 31 and the respective data file containing all the book title information is extracted (step 304). The print cycle then commences (step 306). The pages of the book are printed on both sides of the page, as described hereinabove with reference to Figs. 7-7A (step 308) and the printed pages are stored in the page collect bin of the collating unit 7, 11 and 12 (step 310).

Simultaneously with page printing, the printing of the covers takes place (step 312), as follows: Firstly, the front cover 90F is printed (step 314). The front cover 90F is then rotated (step 316) and inserted below the printed pages being

collected by the collating unit 12. When printing of the pages has been finished, the back cover 90B is then printed and inserted on top of the printed pages in the collating unit 12 (step 318).

Once the printing is completed and all the pages and covers have been
5 collected, the book making process of collation (step 320) and binding (step 322) take place.

Finally, the complete book is ejected for receipt by the waiting customer (step 324). The total time required to make the book on being ordered depends on the total number of pages within the book, but the process is relatively quick,
10 taking for example two minutes to finish a book of 200 duplex pages and thus conforms with generally accepted user expectations for "immediate" delivery from vending machines.

Thus, all the components of the book printing apparatus illustrated in Fig. 2A can be implemented in a vending machine having a common housing for
15 all the components. In some cases, however, it may be desirable to locate the storage device for the plurality of book titles at a remote location, connected to the vending machine by suitable communication line, to provide a centralized storage for a plurality of such vending machines.

While the invention has been described with respect to one preferred
20 embodiment, it will be appreciated that this was set forth merely for purposes of example, and that many other variations, modifications and applications of the invention may be made. For example, the book vending machine can be utilized for printing other material such as text books, scientific publications, articles and catalogues. It will also be appreciated that pre-cut sheets can be utilized for the
25 supply of paper as well as web rolls hereinbefore described.

CLAIMS

1. A vending machine for making and supplying books on request and in real time comprising:

5 a computer data storage device for storing a plurality of book titles, each including the text and image information, the cover information, and other identification data .

an operating panel including a display for displaying the identification information of the book titles stored in said data storage device, and the user's interface enabling a user to select one of said
10 stored book titles for printing; and

book making apparatus for printing and binding said selected book title for immediate delivery to said user.

2. The apparatus according to claim 1 wherein said book making apparatus comprises:

15 a text and image print engine for printing the text and image information of said selected book title on a plurality of pages;

a covers print engine for printing the cover information of said selected book title on front and back covers material;

20 a collator to collate the printed pages and the front and back covers of the book selected by the user;

a binder for binding the printed pages and covers collated by said collator; and

25 a controller for extracting from said storage device a book title selected by the user, and for controlling said text and images to be printed, said cover information to be printed, said collator, and said binder, thereby to print and bind the book selected by the user.

3. The apparatus according to claim 2 whereas said text and image print engine prints in black and white and whereas said covers print engine prints in color.

- 5 4. The apparatus according to claim 1, wherein said operating panel includes a payment device to be used by the user for paying for the selected book, and a discharge device for discharging the selected book after having being printed by the text/image and color print engines and bound by the binder.
5. The apparatus according to claim 4, wherein said payment device in the operating panel includes a credit card slot for insertion of a credit card by the user.
- 10 6. The apparatus according to either of claims 4 or 5, wherein said operating panel further includes a driver slot for the insertion of an external data carrier containing a book title information, by the user to be printed and bound in place of a book title stored in said data storage device.
- 15 7. The apparatus according to any of claims 3-6 wherein said operating panel further includes at least one display screen for displaying information related to any of said book titles.
- 20 8. The apparatus according to any one of claims 3-7, wherein said operating panel, text and image print engine, cover print engine, collator and binder and operation controllers are all housed within a common housing.
9. The apparatus according to claim 8, wherein said data storage device is also housed within said common housing.
- 25 10. The apparatus according to any of claims 1-9 wherein said text and image print engine includes a plurality of sheets and a sheet fed loading mechanism.
11. The apparatus of 1-10 where said text and image print engine includes a plurality of sheets and a sheet fed loading mechanism.
- 30 12. The apparatus according to any one of claims 1-9, wherein said text and image print engine includes a holder for at least one roll of a paper web, a feeder for feeding the paper web to the text and image print engine,

and a cutter for cutting said paper web into sheets of a page size as controlled by said controller.

13. The apparatus according to claim 12, wherein said cutter is downstream of the text and image print engine such that said paper web is cut into sheets after the text has been printed by the text and image print engine.
14. The apparatus according to claim 12, wherein said cutter is upstream of the text and image print engine such that said paper web is cut into sheets before the text has been printed by the text and image print engine.
15. The apparatus according to any one of claims 12-14, wherein said text and image print engine includes a plurality of holders for holding a plurality of rolls of paper web, each holder including a sensor for sensing the quantity of paper web in the respective holder, and for actuating said controller to automatically switch-over to another holder when the paper web in the respective holder approaches depletion.
16. The apparatus according to claim 15, wherein said text and image print engine further includes a holder guide for each roll holder for guiding the paper web therefrom;
an exit guide;
and an indexible guide between all the holder guides and said exit guide, and indexible by said controller to selectively align one of said holder guides with said exit guide.
17. The apparatus according to claim 16, wherein said holders and holder guides are arcuately arrayed over said indexible guide, said indexible guide, said indexible guide being pivotable to selectively align one of the holder guides with said exit guide.
18. The apparatus according to claim 17, wherein said holder guides are of two different lengths, the guides of one length alternating with those of the other lengths, to minimize the space occupied by the holders and their respective paper web rolls.

19. The apparatus according to any one of claims 16-18, wherein each of said guides includes a fixed guide element, and a pivotal guide element, each of said guide elements including pinch rolls for engaging the paper web when fed there through.
- 5 20. The apparatus according to any one of claims 1-19, wherein said text and image print engine includes:
- a first conveyer system for receiving the paper web with one face facing upwardly;
 - a first print assembly overlying said first conveyer system for
10 printing on said one side of the paper web;
 - a second conveyer system for receiving the paper web from the first conveyer system, with the opposite face of the web facing upwardly;
 - and a second print assembly overlying said second conveyer
15 system for printing on said opposite face of the web facing upwardly.
21. The apparatus according to claim 20, wherein said first and second print assemblies are ink-jet print heads page wide arrays.
22. The apparatus according to claim 21, wherein said text and image print
20 engine further includes a dryer downstream of said first and second conveyer assembly.
23. The apparatus according to any one of claims 1-22, wherein said cover print engine includes:
- a bin for receiving a stack of covers pre-cut to size;
 - a covers print engine assembly for printing the cover information;
 - 25 and a top feeder for feeding the covers sequentially from the top of the stack in the bin to the cover print engine assembly;
 - said cover print engine assembly being controlled by said controller to print the front cover information of a selected book title on one cover, and the back cover information of the selected book
30 title on the immediately succeeding cover.

24. The apparatus according to claim 23, wherein said cover print engine assembly includes a plurality of print heads for printing in color.
25. The apparatus according to claim 24, wherein each of said print heads prints its respective color out to the cover from a colored transfer ribbon.
- 5 26. The apparatus according to claim 25, wherein each of said print heads prints its respective color out to the cover from a color transfer ribbon by a thermal transfer process.
27. The apparatus according to any one of claims 1-26, wherein said collator includes:
- 10 a collator frame;
 a page feeder for feeding the printed pages of text to the collator frame, and to stack the pages therein, starting with the first page, facing downwardly;
 and a cover feeder for feeding said covers to said collator frame, starting with said front cover, and including an inverter for inverting
15 the front cover when fed to the collator frame.
28. The apparatus according to claim 27, wherein said collator further includes:
- 20 fork insertable in an inclined position in said collector frame, said page feeder feeding the printed pages of text/image and stacking them onto the fork, starting with the first page facing downwardly;
 whereas a space is provided between the fork and the collator frame, to permit feeding of said front cover in inverted position into the lower end of the stack, and said back cover to the upper end of
25 the stack;
 and a clamping plate actuated by said controller for clamping the two covers with the stack of pages there between, in preparation for their binding by the binder.
29. The apparatus according to any one of claims 1-28, wherein said binder
30 includes an adhesive applicator for applying adhesive to the edge of the printed pages and the cover collated by the collator.

30. The apparatus according to any one of claims 1-28, wherein said binder includes a tape applicator for applying adhesive tape to one edge of the printed pages and the covers collated by the collator.

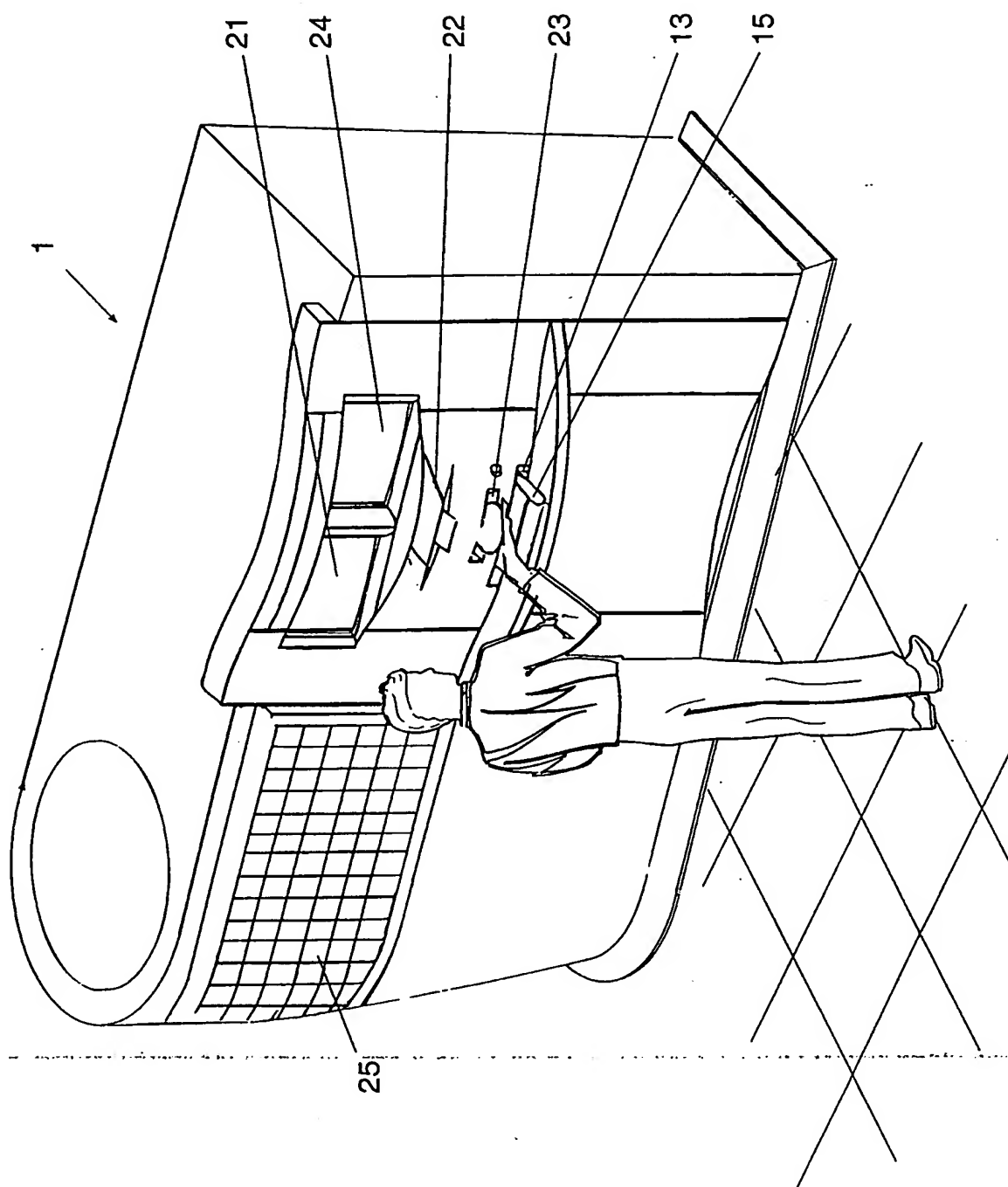


FIG. 1

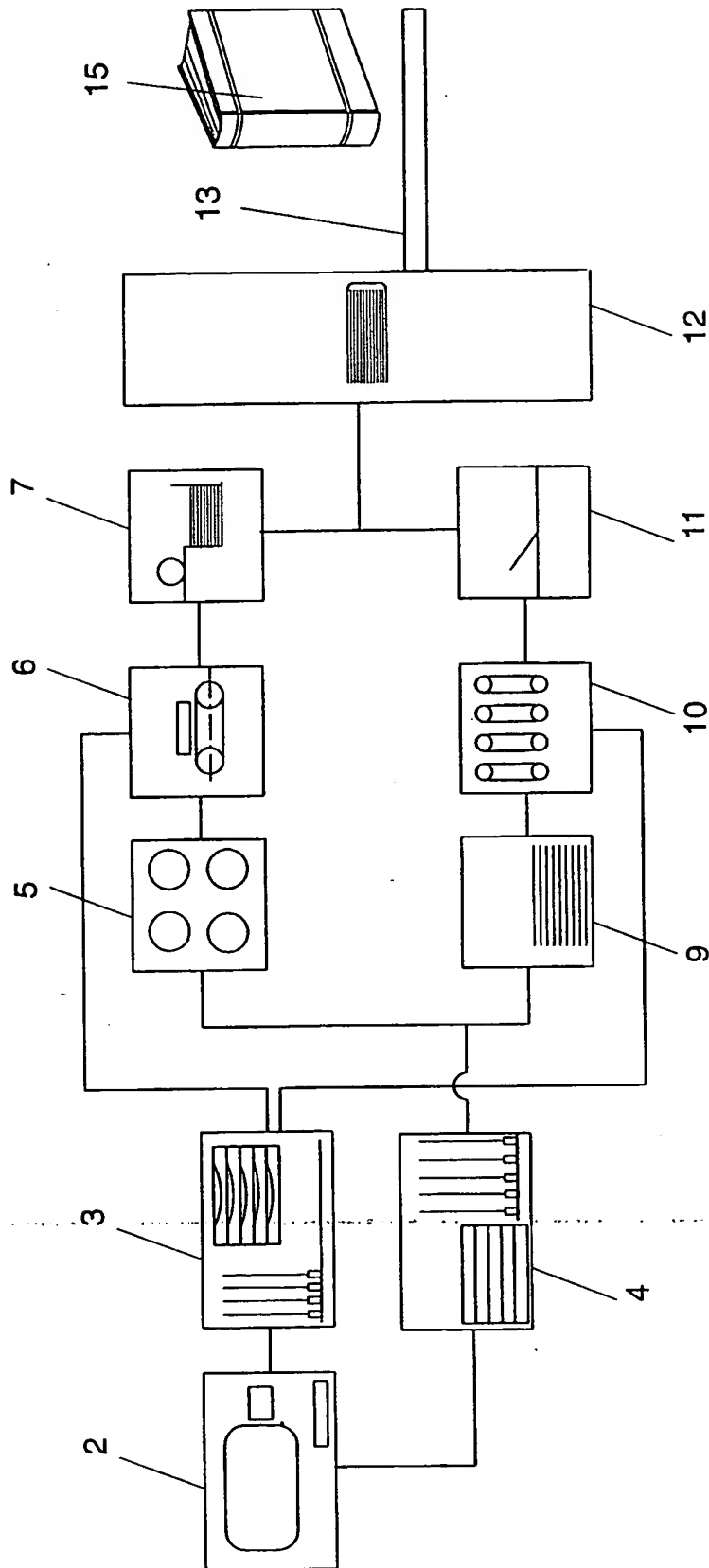


FIG. 2A

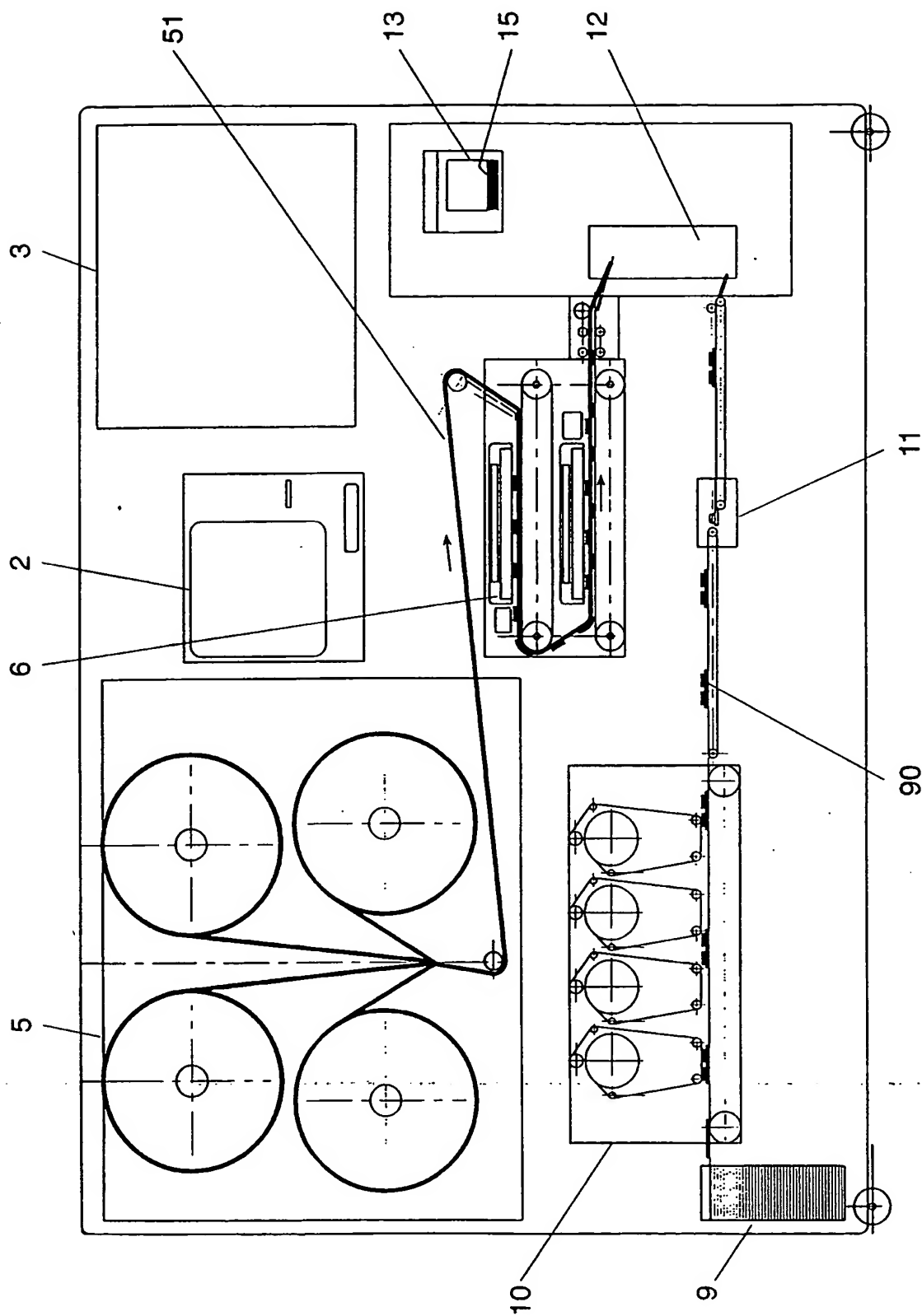


FIG. 2B

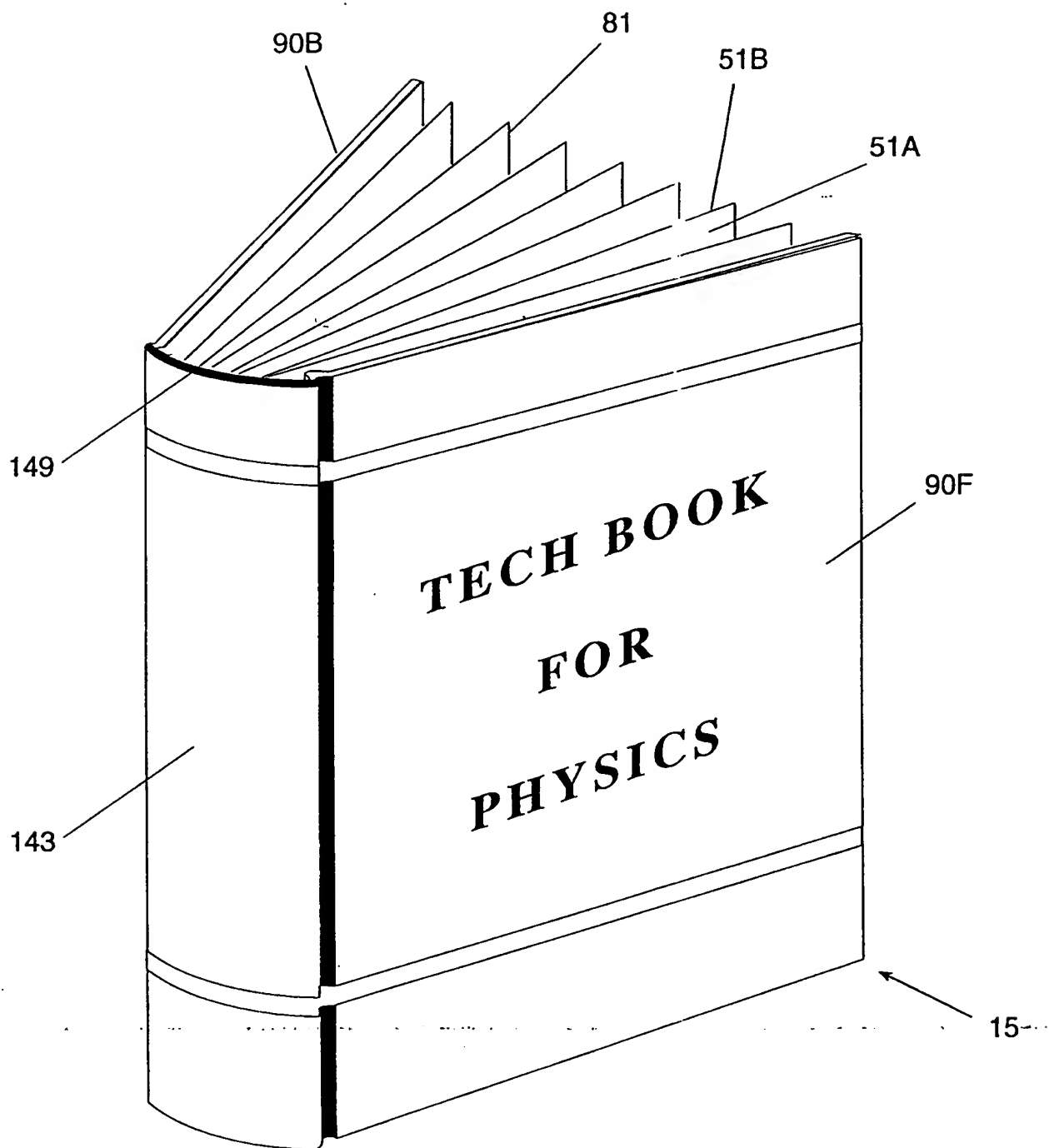


FIG. 2C

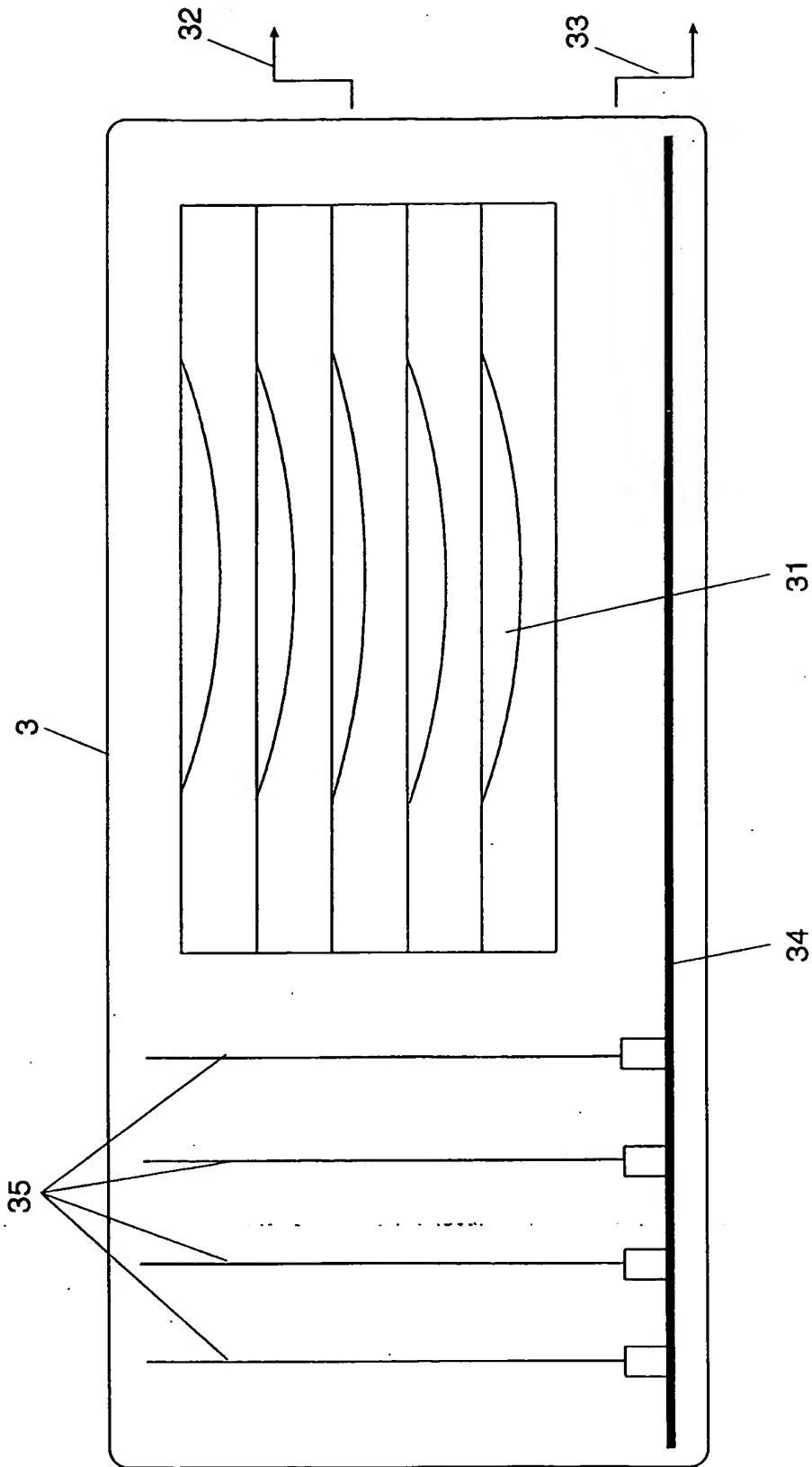


FIG. 3

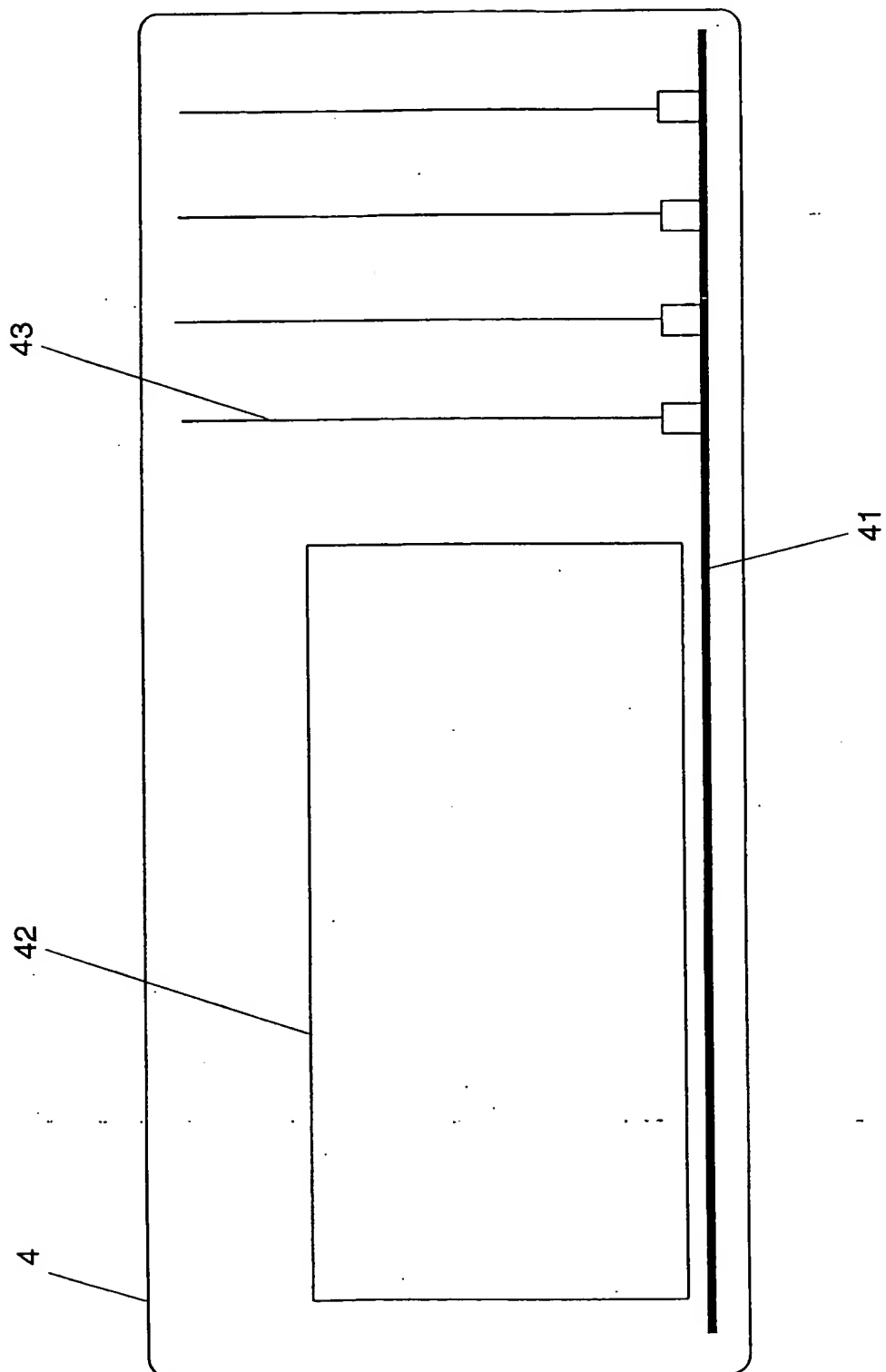


FIG. 4

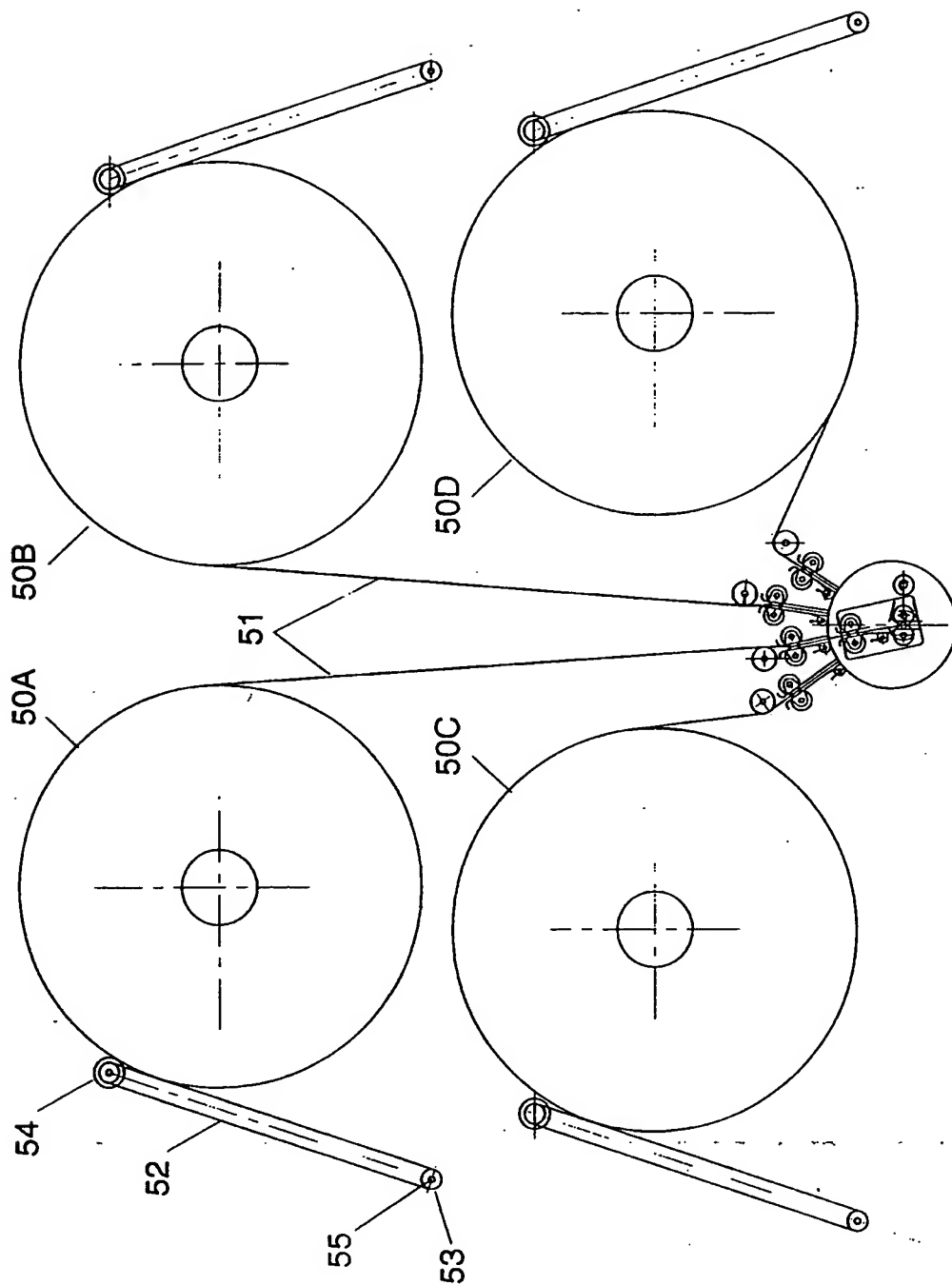


FIG. 5

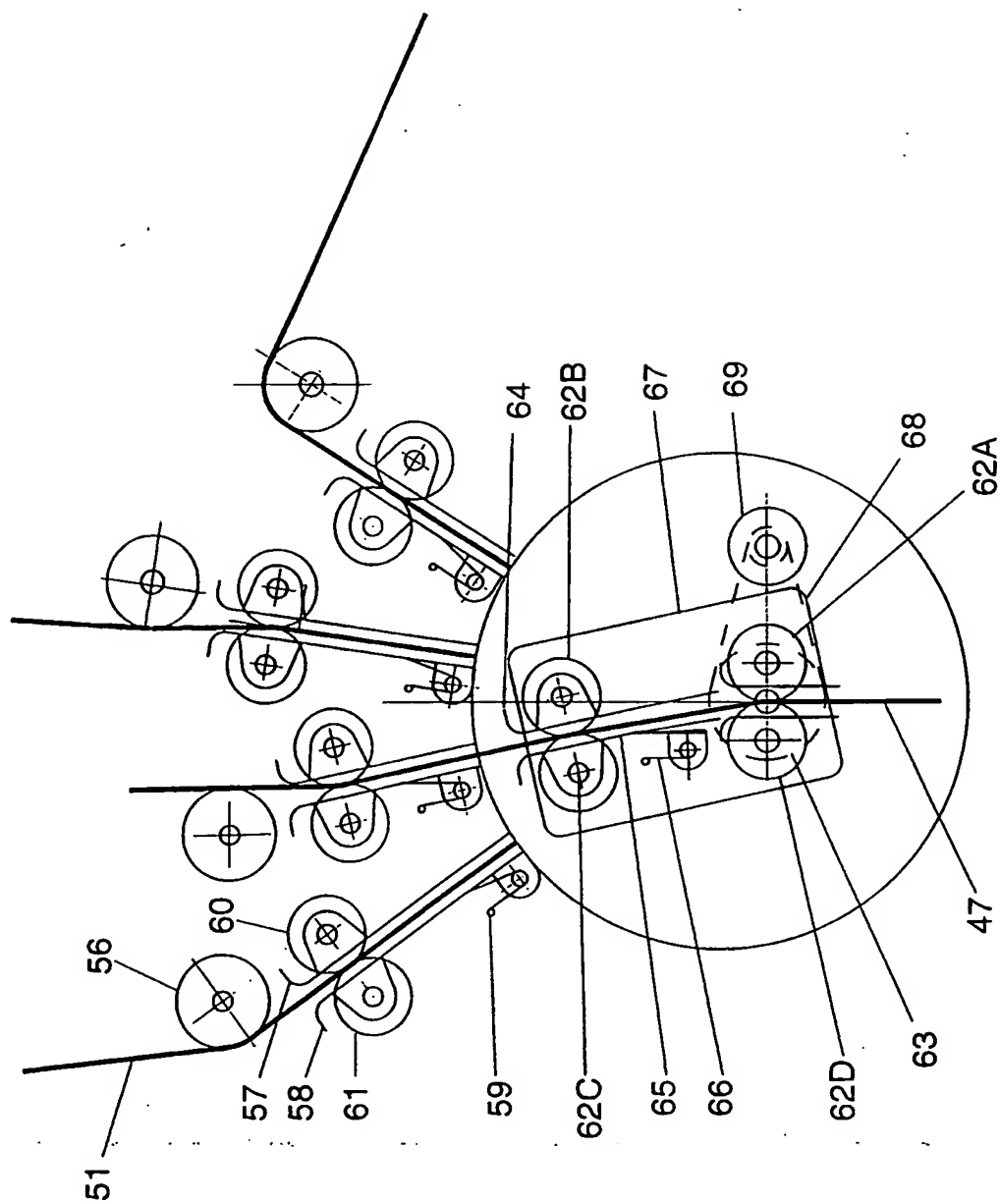


FIG. 6

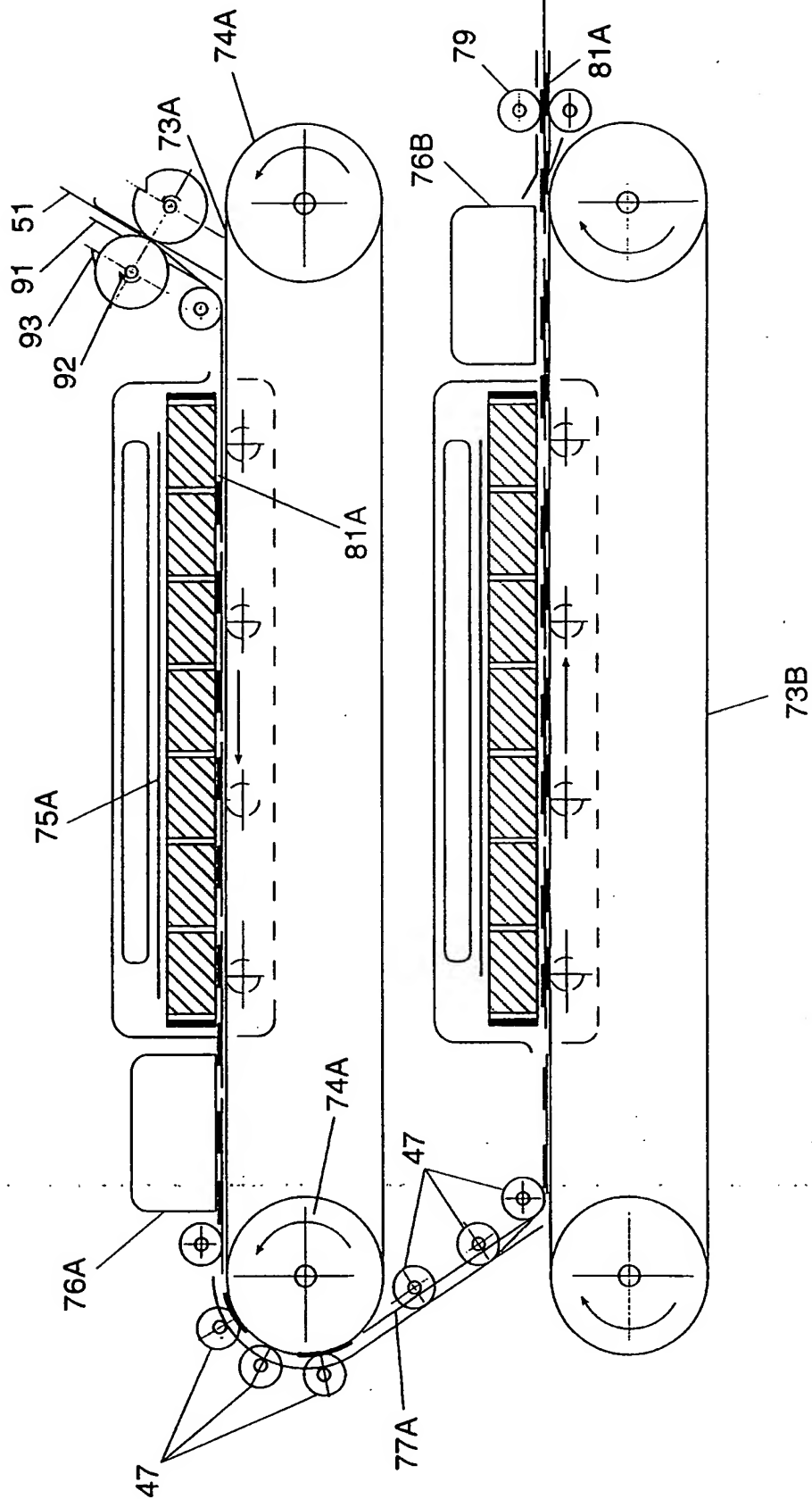


FIG.7A

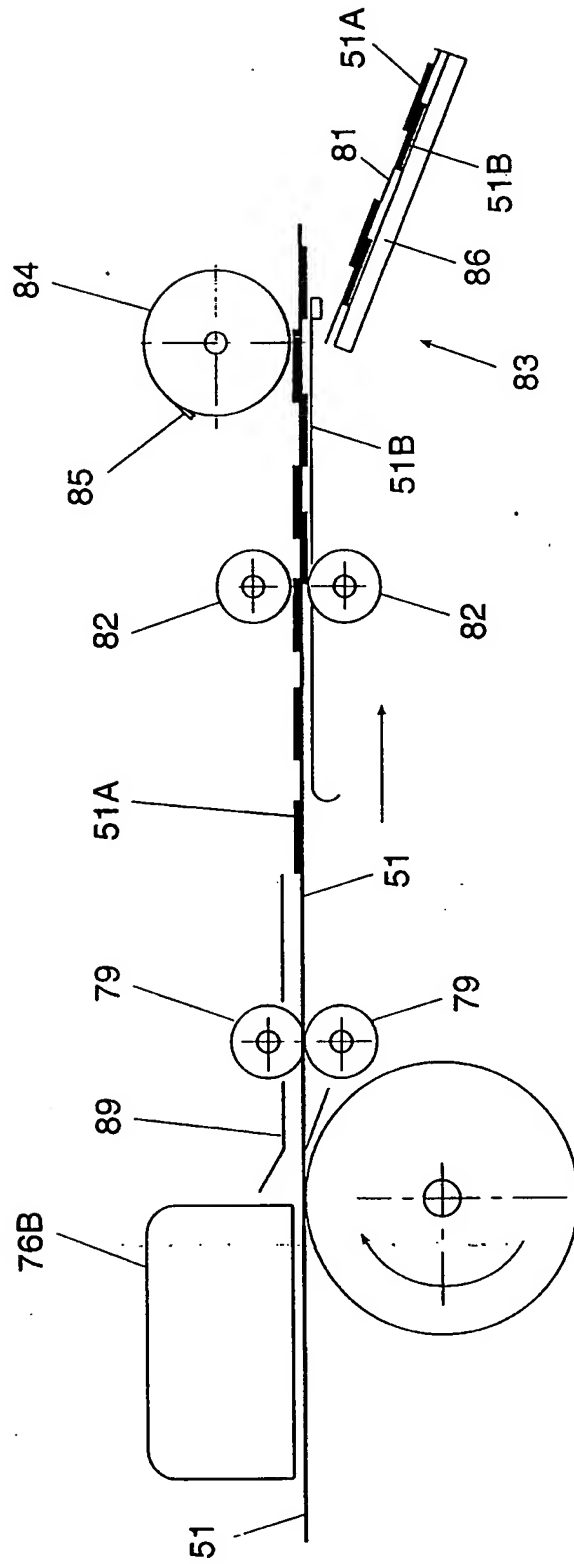


FIG. 8

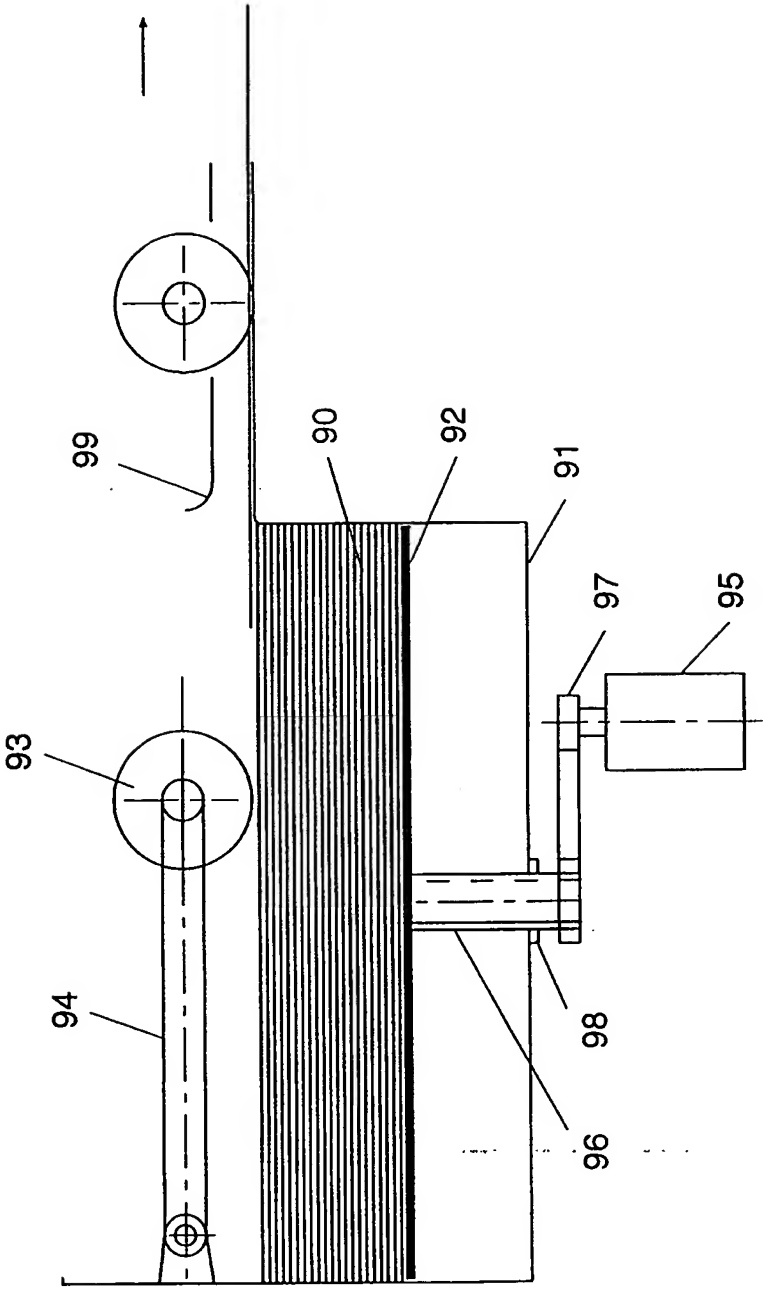


FIG. 9

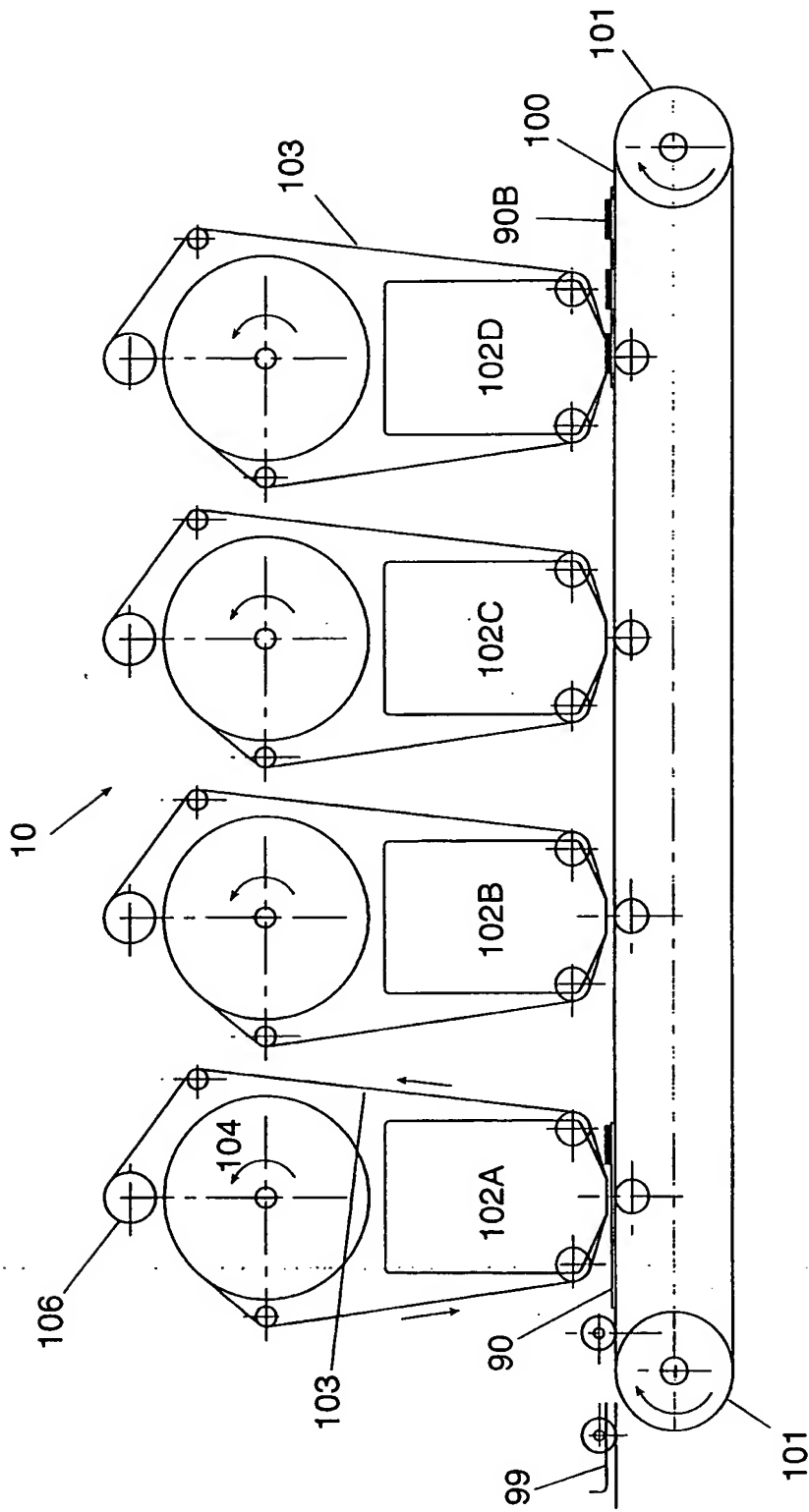


FIG. 10

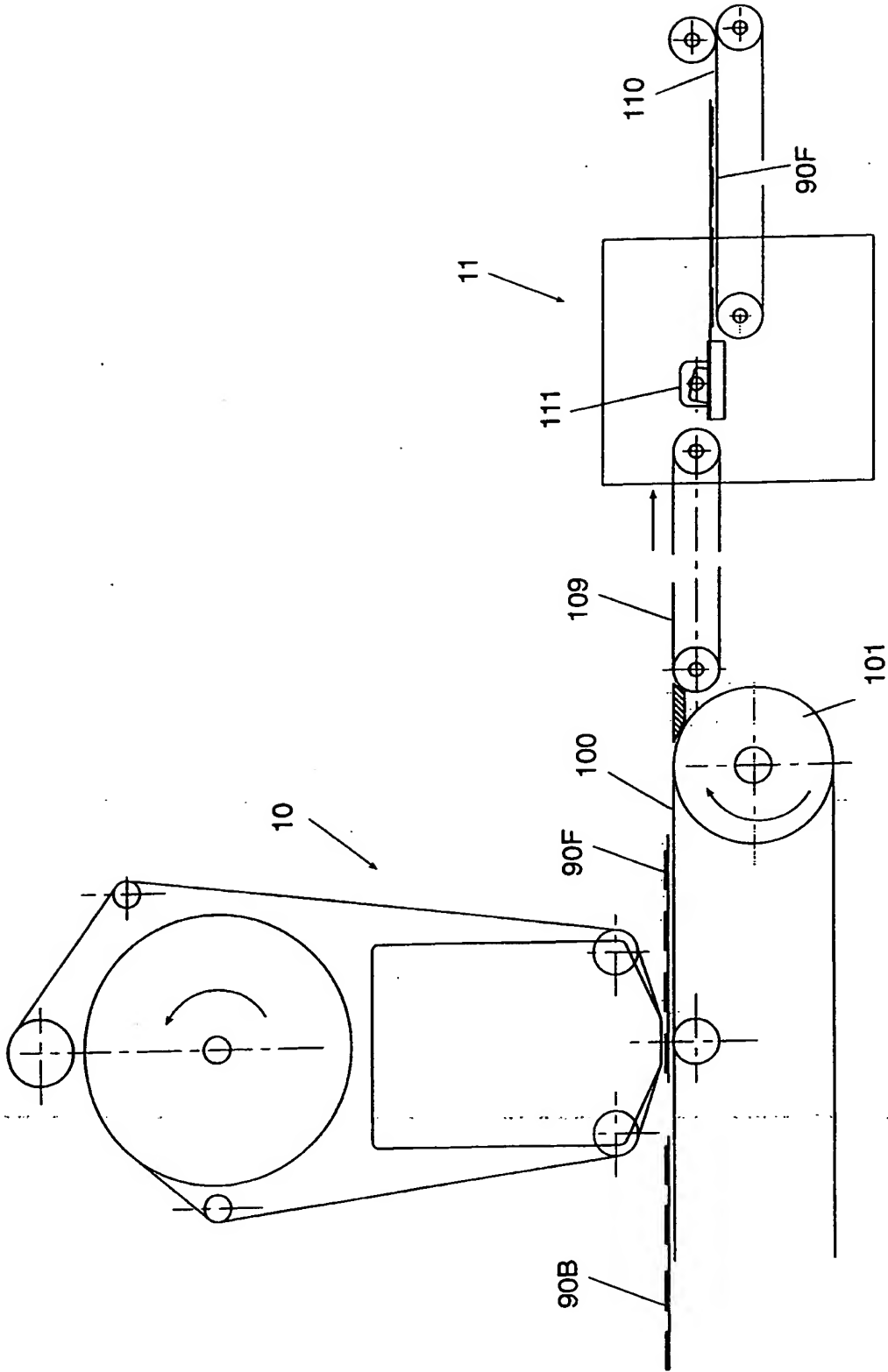
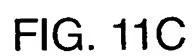
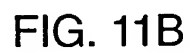
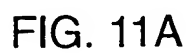


FIG. 10 A



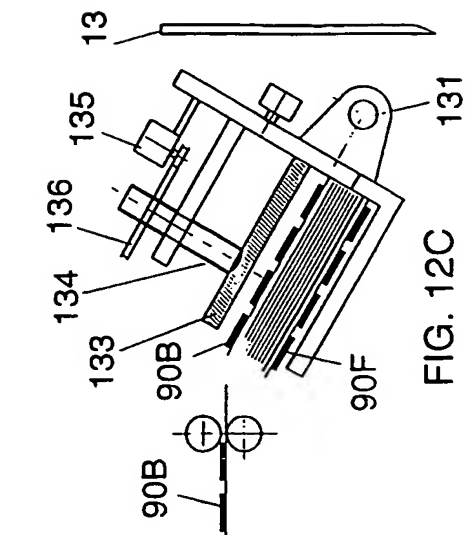


FIG. 12C

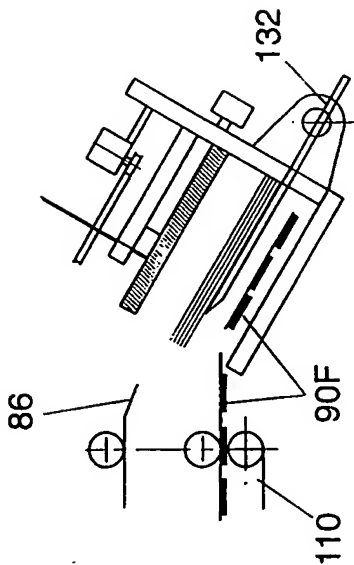


FIG. 12B

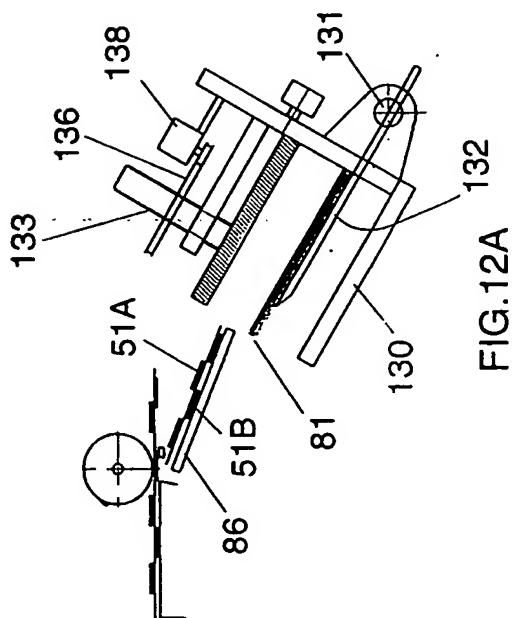


FIG. 12A

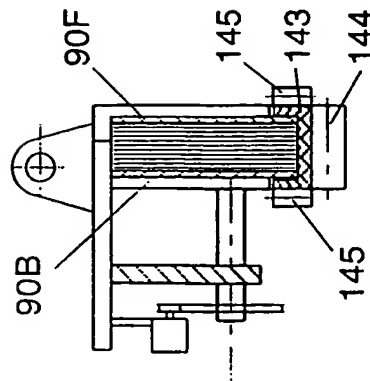


FIG. 13C

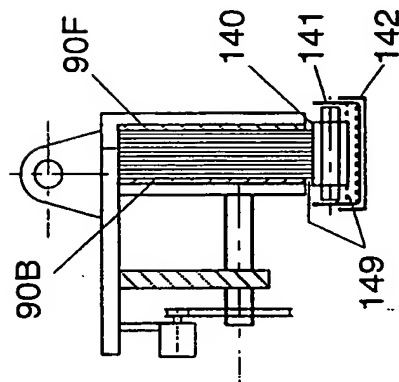


FIG. 13B

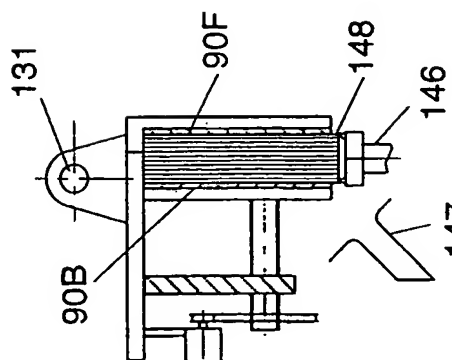


FIG. 13A

elue

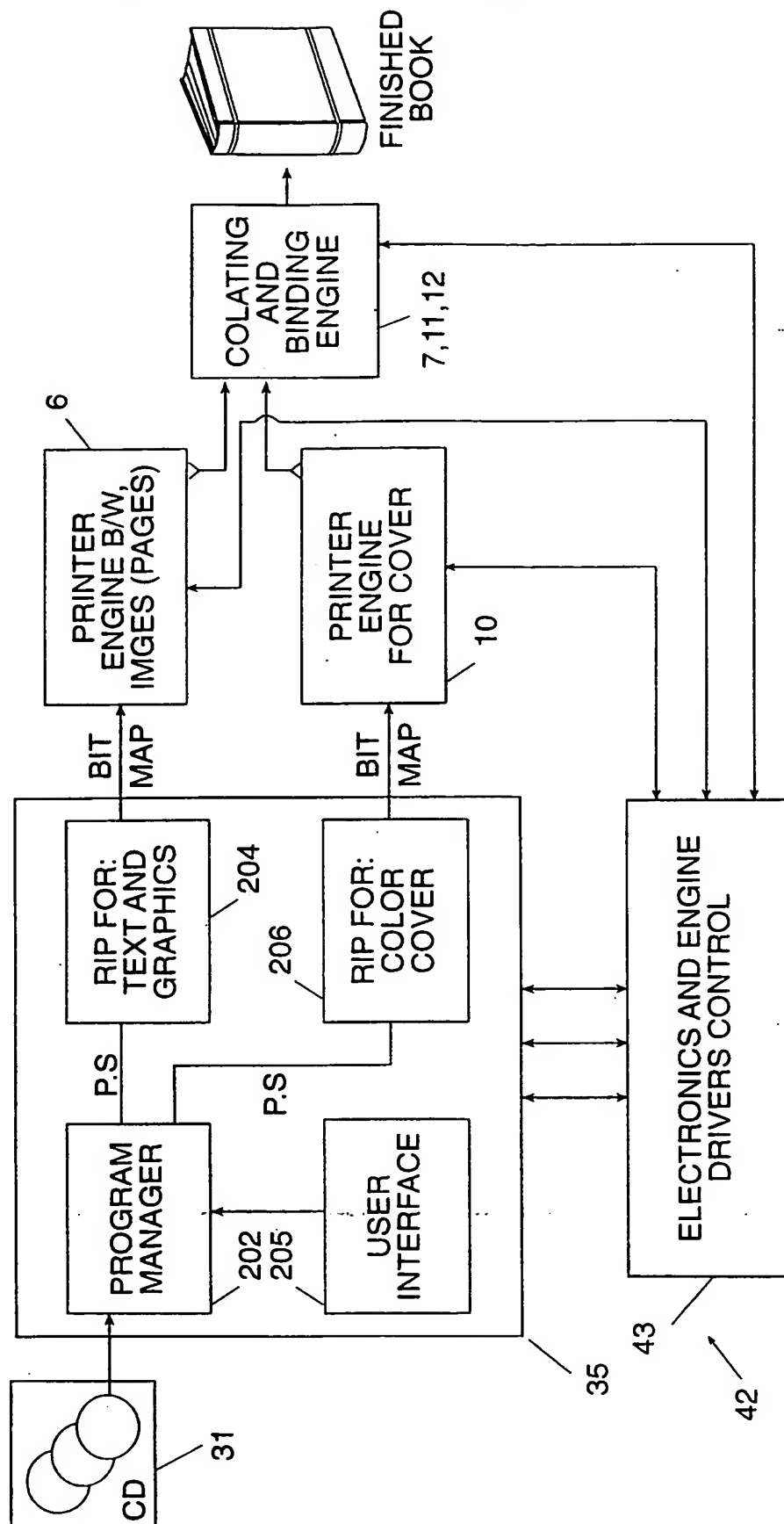


FIG. 14

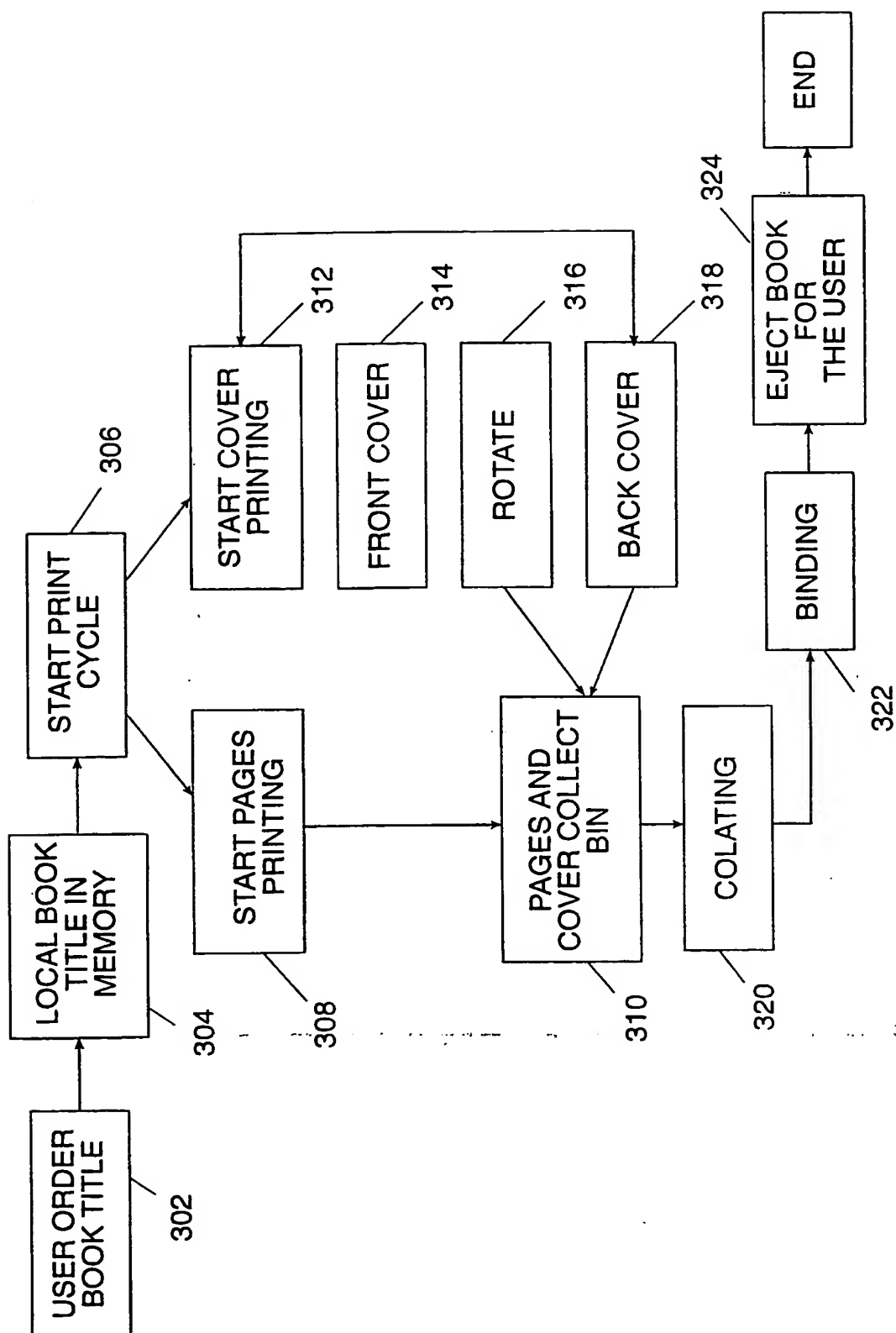


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL99/00390

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B41F 13/64; B42B 43/00; B42D 15/00

US CL : 270/12; 412/1; 283/ 67, 70, 117

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 270/12; 412/1; 283/ 67, 70, 117

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,982,744 A (KRAYNAK ET AL.) 28 SEPTEMBER 1976, SEE ENTIRE DOCUMENT	1-30
Y	US 3,892,427 A (KRAYNAK ET AL.) 01 JULY 1975, SEE ENTIRE DOCUMENT	1-30
Y	US 5,524,932 A (KALISHER) 11 JUNE 1996, SEE ENTIRE DOCUMENT	1-30
Y	US 4,143,889 A (SCHARLIN) 13 MARCH 1979, SEE ENTIRE DOCUMENT	1-30
Y	US 5,190,316 A (HEFTY) 02 MARCH 1993, SEE ENTIRE DOCUMENT	1-30



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z"

document member of the same patent family

Date of the actual completion of the international search

21 OCTOBER 1999

Date of mailing of the international search report

03 NOV 1999

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